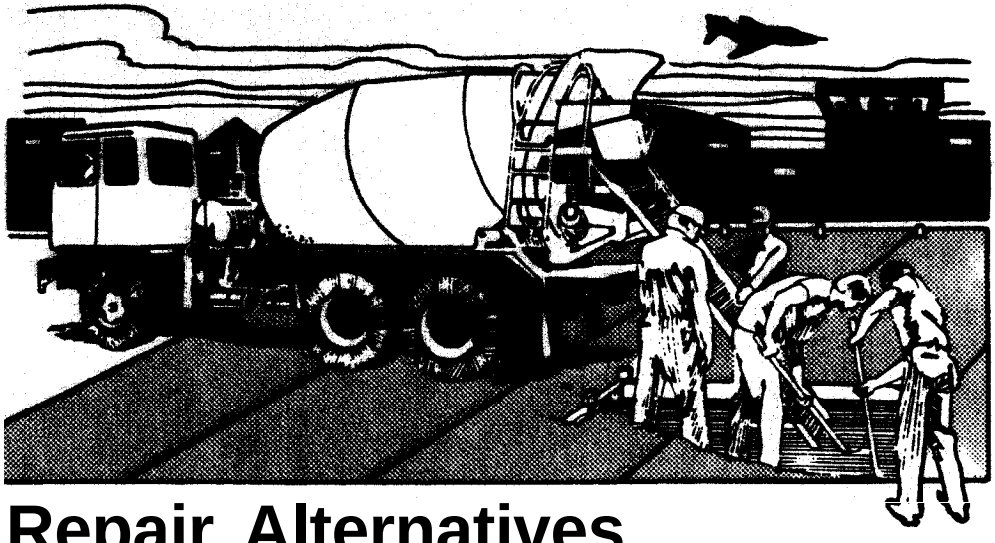
Naval Facilities Engineering Command
200 Stovall Street
Alexandria, Virginia 22332-2300

NAVFAC MO-102.4

JOINTED CONCRETE AIRFIELDS



Maintenance & Repair Alternatives

Pavement Condition Index (PCI) Field Manual

S/N 0520-LP-173-0110

June 1989

Distribution:

A3	CNO	B3	COLLEGE & UNIVERSITY
A6	CNC	B5	USCG

(25 copies each)

FKA1C	COMNAVFACENGCOM	FKN1	EFDs

(10 copies each)

FA46	PWC LANT	U.S. Army	
FB54	PWC PAC	office Chief of Engineers	
FKP7	NAVSHIPYDs	Washington, DC 20314	
FT104	PWC CNET	(DAEN-MPO)	
HQ U.S. Air Force		U.S. Army	
Engineering and Services Center		Engineering & Housing Support Center	
Tyndall APB, FL 32403		Fort Belvoir, VA 22060-5516	

(5 copies each)

FF38	USNA	FT31	NTC
FF42	NAVPGSCOL	FT-37	NAVSCOLCECOFF
FT28	NETC	FT55	NAVSCSCOL

(2 copies each)

21A	FLECOMNCH	C28E	COMNAVBASDET
22A	FLECOM	C31B	NAVSTADET
23A	NAVFORCOM	C31F	NAVFACDET
23C	NAVRESFORDET	C31G	NAVSHIPREPFACDET
24G	SUFORCOM	C34B	NAVSTA ROTA DET
26B	NAVSRESFORDET	C34C	NAVSUPPACT NAPLES DET
26U	SFORLANTREADSUPPGRU	C40	NAVOCEANCOMDET (Only
26W	CARGOHANDPORTGRU		Charleston, Gulfport,
26Z	SHOREINTERMAINTACT		Newport, FPO Seattle,
26NN	LANTFLESCLSHIPENGTRATEAM		FPO Miami)
26VV	SUFORREP	C84D	NAWSBAWARENGSTADET
26XX	OCEANU	E3A	LAB ONR
39	CBREGIHDET	E3C	NORDA
45H	ENGBCO	FA7	NAVSTA LANT
45J	HQB	FA10	SUBASE LANT
51D1	EASTLANTCOM	FA13	NAVSUBSUPPFACLANT
51D2	WESTLANTCOM	FA23	NAVFAC LANT

Distribution: (2 copies each)

B8	COMUSMARDEZ	FA32	CBU LANT
C20A	ONRDET	FB10	NAVSTA PAC
C20B	ONR	FB13	SUBASE PAC
C20C	NRLDET(Chesapeake Beach, Orlando only)	FB28	COMNAVBASE PAC
		FB36	NAVFAC PAC
C20G	NAVOCEANSYSCENDET	FB41	CBU PAC
C20H	DAVTAYR&DCENDET	FB45	TRIREFFACPAC
FB48	NAVSUPPFAC PAC	FKP1J	NAVORDSTAs
FC1	FOCCEUR	FKP3A	NAVPRO
FC3	COHNAVACT EUR	FKP5A	NAVSEACEN
FC5	NAVSUPPACT EUR	FKQ6B	NAVCOASTSYSCEN
FC7	NAVSTA EUR	FKQ6C	NAVOCEANSYSCEN
FC12	NAVSUPPO EUR	FR15	NAVSUPPACT COMNAVRESFOR
FD1	COMNAVOCEANCOM	FR18	NAVRESMAINTRAFAC
FD4	OCEANCEN	FT1	CNET
FF1	COMNAVDIST Washington DC	FT15	NAVU
FF3	NAVSTA CNO	FT18	CBU
FF18	NAVTACSUPPACT	FT20	NAVCONSTRACEN
FF32	FLDSUPPACT	FT24	FLETRACEN
FF65	SNSPO	FT60	EDTRASUPPCEN
FKA1	SYSCOMHQS	FT78	NAVEDTRAPRODEVCEN
FKA8F2	NAVPRO	FT85	TRITRAFAC
FKA8F5	SUBASE	V2	MARBKS
FKN2	CBCs	V12	CG MCDEC
FKN3	OICCS	V14	HQBN HQMC
FKN1O	NAVSUPPFAC	V16	CG MCB (less Oahu)
FKN11	NAVCIVENGRLAB	V17	MARCORCAMP
FKP1B	WPNSTAs	V23	CG MCLB

(200 copies)

FKN1 EFD (Northdiv only)

Additional copies may by obtained from:

Commanding Officer
Northern Division
Naval Facilities Engineering Command
Philadelphia, PA 19112-5094
ATTN: Code 1038

ABSTRACT

This field manual contains maintenance and repair alternatives along with information on distress definitions and measuring methods for asphalt surfaced airfields. These definitions and measuring methods are keyed to the determination of the Pavement Condition Index (PCI). This field manual was written for Engineers, Planners and Estimators, and Inspectors to be used on-site. Total list of field manuals:

No.	Title	Est. Compl. Date
MO-102	Maintenance and Repair of Surfaced Areas	09/89
MO-102.1	Asphalt Surfaced Roads & Parking Lots	04/89
MO-102.2	Jointed Concrete Roads & Parking Lots	04/89
MO-102.3	Asphalt Surfaced Airfields	08/89
MO-102.4	Jointed Concrete Airfields	08/89
MO-102.5	Pavement Maintenance Management	08/90
MO-102.6	Asphalt Crack Repair	12/89
MO-102.7	Concrete Repair	03/90
MO-102.8	Asphalt Repair	12/90

FOREWORD

This field manual contains maintenance and repair alternatives along with information on distress definition and measuring methods for portland cement concrete airfields. These definitions and measuring methods are keyed to the determination of the Pavement Condition Index (PCI) that will be explained in Manual, MO-102.5, "Pavements Maintenance Management" (scheduled for August 1990). The pavement condition rating is based on the PCI, which is a numerical indicator based on a scale of 0 to 100. The PCI measures the pavement's structural integrity and surface operational condition. The method presented is intended to accomplish pavement inspection in the most efficient and cost effective manner.

Recommendations or suggestions for modification, or additional information and instruction that will improve the publication and motivate its use, are invited and should be forwarded to the Commander, Naval Facilities Engineering Command (Attention: Code 163), 200 Stovall Street, Alexandria, VA 22332-2300. Telephone: Commercial (202) 325-0045.

This publication has been reviewed and is approved for certification as an official publication of this Command in accordance with SECNAV Instruction 5600.16.

G. F. EVERHART
CAPT, CEC, US NAVY
Assistant Commander for
Public Works Centers and Departments

Table of Contents

DEFINITIONS OF REPAIR OPTIONS
as used in this manual

1. Grinding - Closely spaced diamond blades are used to remove material and provide a smooth surface.

2. Joint Reconstruction - The joint is replaced by resawing the joint after one or both sides of the joint have been patched and/or doweling to provide load transfer.

3. Patching:
   Partial Depth - When the distress effects only the top few inches of the slab, the weakened concrete is removed down to sound concrete and the area patched.

   Full Depth - When the distress extends through the slab the affected area is saw cut and removed down to the base. The base should be recompacted.

4. Seal Cracks - Cracks should be routed to remove any incompressibles before sealing.

5. Underseal - Undersealant, such as cement grout, is inserted pressure beneath the slab to fill voids and resist future pumping action. It is recommended that load transfer be provided if needed to extend the life of the pavement.

BLOW-UP

Description: Blow-ups occur in hot weather, usually at a transverse crack or joint that is not wide enough to permit expansion of the concrete slabs. The insufficient width is usually caused by infiltration of incompressible materials into the joint space. When expansion cannot relieve enough pressure, a localized upward movement of the slab edges (buckling) or shattering will occur in the vicinity of the joint. Blow-ups can also occur at utility cuts and drainage inlets. This type of distress is almost always repaired immediately because of severe damage potential to aircraft. The main reason blow-ups are included here is for reference when closed sections are being evaluated for reopening.

Severity Levels:

L - Buckling or shattering has not rendered the pavement inoperative, and only a slight amount of roughness exists. (Figure 80)

M -Buckling or shattering has not rendered the pavement inoperative, but a significant amount of roughness exists. (Figure 81)

H - Buckling or shattering has rendered the pavement inoperative. (Figure 82)

Note: For the pavement to be considered operational, all foreign material from the blow-up must have been removed.

How to Count:

A blow-up usually occurs at a transverse crack or joint. At a crack it is counted as being in one slab, but at a joint, two slabs are affected and the distress should be recorded as occurring in two slabs.

Blow-up 61

Options for Repair:

L* - Partial or full depth patch; Slab replacement.

M* - Partial or full depth patch; Slab replacement.

H* - Full depth patch; Slab replacement.

* Must provide expansion joints.

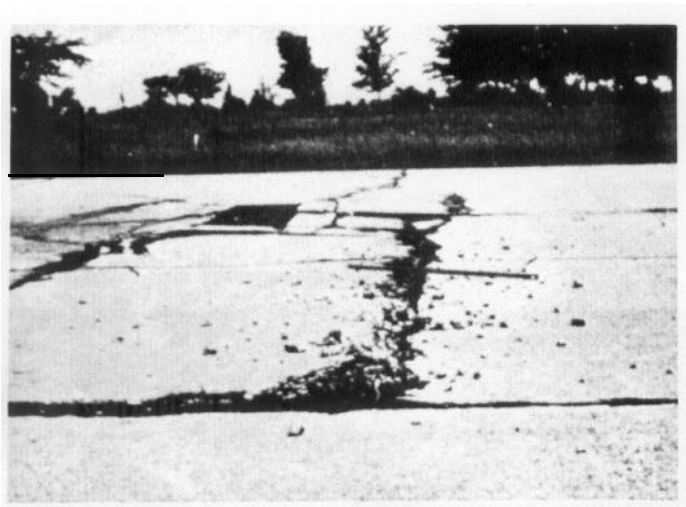


Figure 80. Low severity blow-up (note that this would only be considered low severity if the shattering in the foreground was the only part existing and the foreign material removed)

Figure 81. Medium severity blow-up

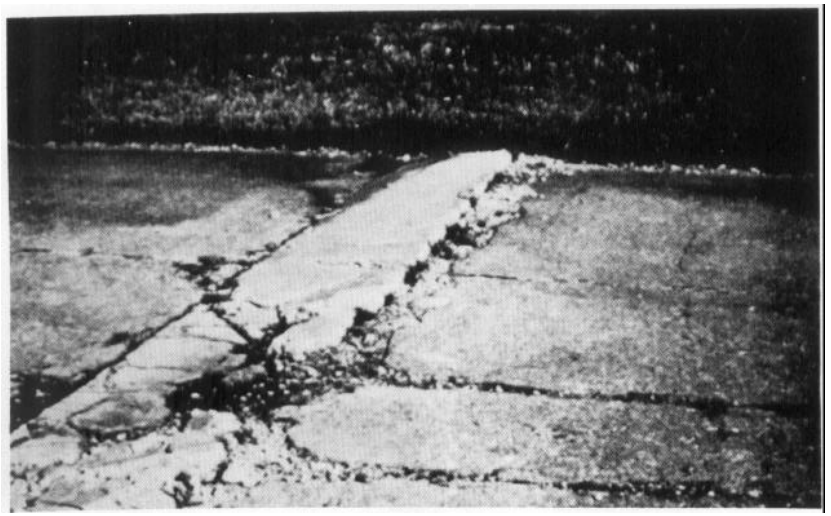


Figure 82. High severity blow-up

CORNER BREAK

Description: A corner break is a crack that intersects the joints at a distance less than or equal to one-half the slab length on both sides, measured from the corner of the slab. For example, a slab with dimensions of 25 by 25 feet (7.5 by 7.5 meters) that has a crack intersecting the joint 5 feet (15m) from the corner on one side and 17 feet (5.1 m) on the other side is not considered a corner break: it is a diagonal crack. However, a crack that intersects 7 feet (2.1 meters) on one side and 10 feet (3m) on the other is considered a corner break. A corner break differs from a corner spall in that the crack extends vertically through the entire slab thickness, while a corner spall intersects the joint at an angle. Load repetition combined with loss of support and curling stresses usually causes corner breaks.

Severity Levels:

L - Crack has either no spalling or minor spalling (no FOD potential). If non-filled, it has a mean width less than approximately 1/8 inch (3.2 mm); a filled crack can be of any width, but the filler material must be in satisfactory condition. The area between the corner break and the joints is not cracked. (Figures 83 and 84)

M -One of the following conditions exists: (1) filled or nonfilled crack is moderately spalled (some FOD potential); (2) a nonfilled crack has a mean width between 1/8 inch (3.2 mm) and 1 inch (25.4 mm); (3) a filled crack is not spalled or only lightly spalled, but the filler is in unsatisfactory condition; (4) the area between the corner break and the joints is lightly cracked. (Figures 85 and 86)

Corner Break 62

H -One of the following conditions exists: (1) filled or nonfilled crack is severely spalled, causing definite FOD potential; (2) a nonfilled crack has a mean width greater than approximately 1 inch (25.4 mm), creating a tire damage potential: or (3) the area between the corner break and the joints is severely cracked. (Figure 87)

How to Count: A distressed slab is recorded as one slab if it (1) contains a single corner break, (2) contains more than one break of a particular severity, or (3) contains two or more breaks of different severities. For two or more breaks, the highest level of severity should be recorded. For example, a slab containing both light and medium severity corner breaks should be counted as one slab with a medium severity corner break.

Options for Repair:

L* - Do nothing; Seal cracks.

M* - Seal cracks; Full depth patch; Slab replacement.

H* - Seal cracks; Full depth patch; Slab replacement.

* Check for voids, consider undersealing project.

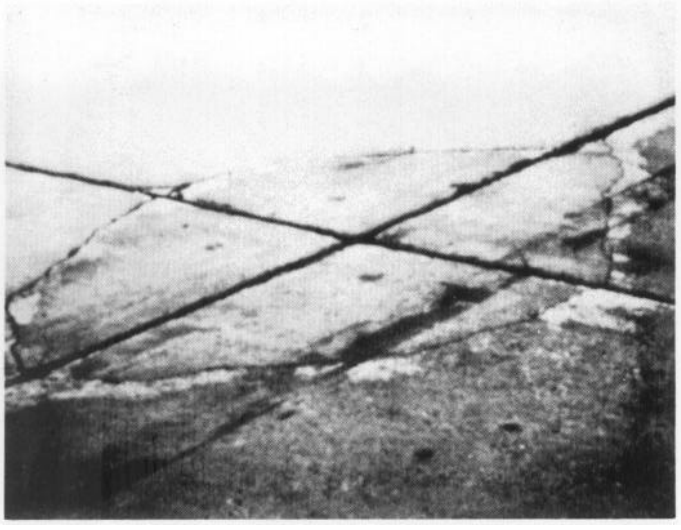


Figure 83. Low severity corner break

Figure 84. Low severity corner break

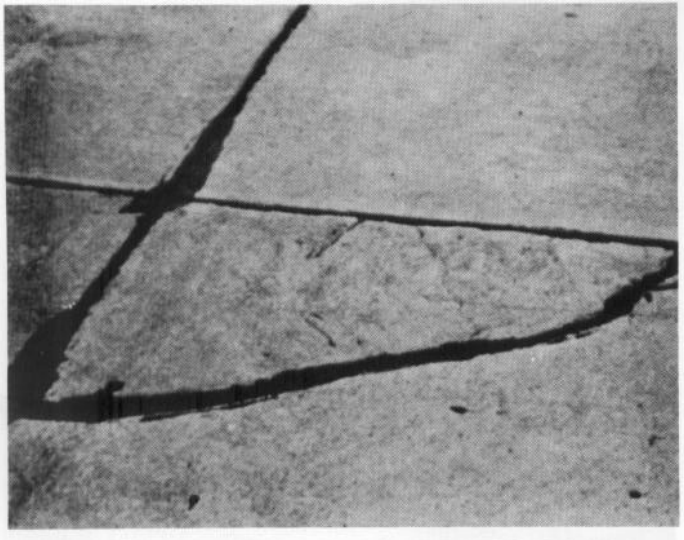


Figure 85. Medium seventy corner break (area between the corner break and the joints is lightly cracked)

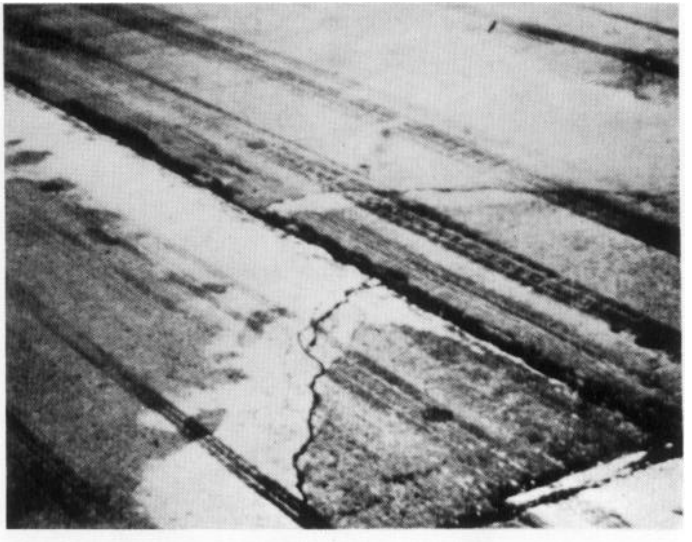


Figure 86. Medium severity corner break

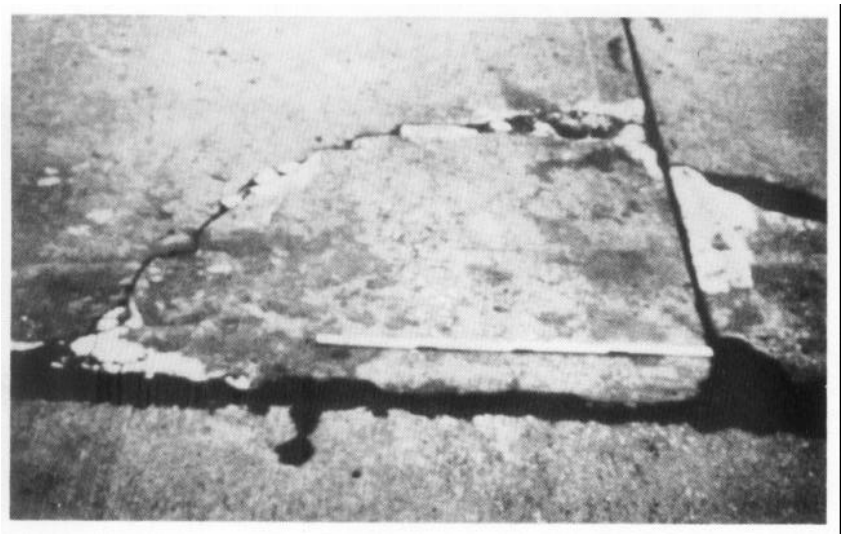


Figure 87. High severity corner break

CRACKS: LONGITUDINAL, TRANSVERSE, AND DIAGONAL

Description: These cracks, which divide the slab into two or three pieces, are usually caused by a combination of load repetition, curling stresses, and shrinkage stresses. (For slabs divided into four or more pieces see Shattered Slab/Intersecting Cracks.) Low severity cracks are usually warping - or friction-related and are not considered major structural distresses. Medium or high severity cracks are usually working cracks and are considered major structural distresses.

NOTE: Hairline cracks that are only a few feet long and do not extend across the entire slab are rated as shrinkage cracks.

Unreinforced PCC:

Severity Levels:

L- (1) crack has no spalling or minor spalling (no FOD potential). If nonfilled, it is less than 1/8 inch (3.2 mm) wide; a filled crack can be of any width, but its filler material must be in satisfactory condition; or (2) the slab is divided into three pieces by low severity cracks. (Figures 88, 89, and 90)

M - One of the following conditions exists: (1) a filled or nonfilled crack is moderately spalled (some FOD potential); (2) a nonfilled crack has a mean width between 1/8 inch (3.2mm) and 1 inch (25.4 mm); (3) a filled crack has no spalling or minor spalling, but the filler is in unsatisfactory condition; or (4) the slab is divided into three pieces by two or more cracks, one of which is at least medium severity. (Figures 91, 92, and 93)

H - One of the following conditions exists: (1) a filled or nonfilled crack is severely spalled (definite FOD potential; or (2) a nonfilled crack has a mean width approximately greater than 1 inch (25.4 mm), creating tire damage potential. (Figures 94, 95, and 96)

Reinforced Concrete:

Severity Levels:

L - (1) Nonfilled crack 1/8 inch (3.2 mm) to 1/2 inch (12.7 mm) wide with no faulting or spalling; (2) filled or nonfilled cracks of any width <1/2 inch (12.7 mm) with low severity spalling; or (3) filled cracks of any width (filler satisfactory), with no faulting or spalling.

Note: Crack less than 1/8 inch (3.2 mm) wide with no spalling or faulting should be counted as shrinkage cracking.

M - (1) Nonfilled cracks 1/2 inch (12.7 mm) to I inch (25.4 mm) wide, no faulting or spalling; or (2) filled cracks of any width with faulting <3/8 inch (9.6mm) or medium severity spalling.

H - (1) Nonfilled cracks of width >1 inch (25.4 mm); **(2)** nonfilled cracks of any width with faulting >3/8 inch (9.6 mm) or medium severity spalling; or (3) filled cracks of any width with faulting >3/8 inch (9.6 mm) or high severity spalling.

How to Count:

Once the severity has been identified, the distress is recorded as one slab. If a crack is repaired by a narrow patch [e.g., 4 to 10 inches (102 to 254 mm) wide] only the crack and not the patch should be recorded at the appropriate severity level.

Options for Repair:

L - Do nothing; Seal cracks.

M - Seal cracks.

H - Seal cracks; Full depth patch; Slab replacement.

Figure 88. Low severity longitudinal crack

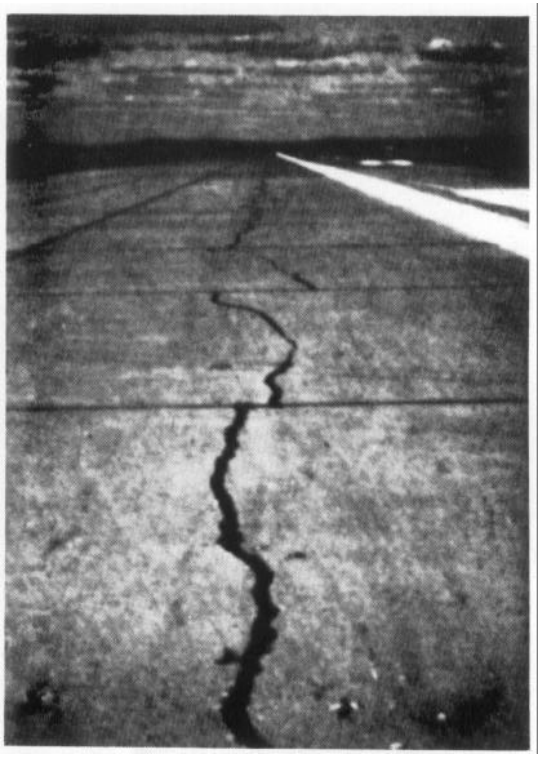


Figure 89. Low severity filled longitudinal cracks

Figure 90. Low severity diagonal crack

Figure 91. Medium seventy longitudinal crack

Figure 92. Medium seventy transverse crack

Figure 93. Medium severity transverse crack

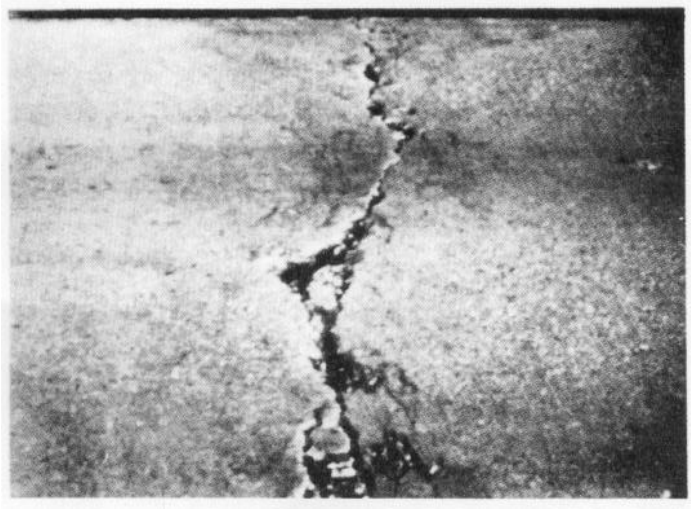


Figure 94. High seventy crack

Figure 95. High seventy longitudinal cracks

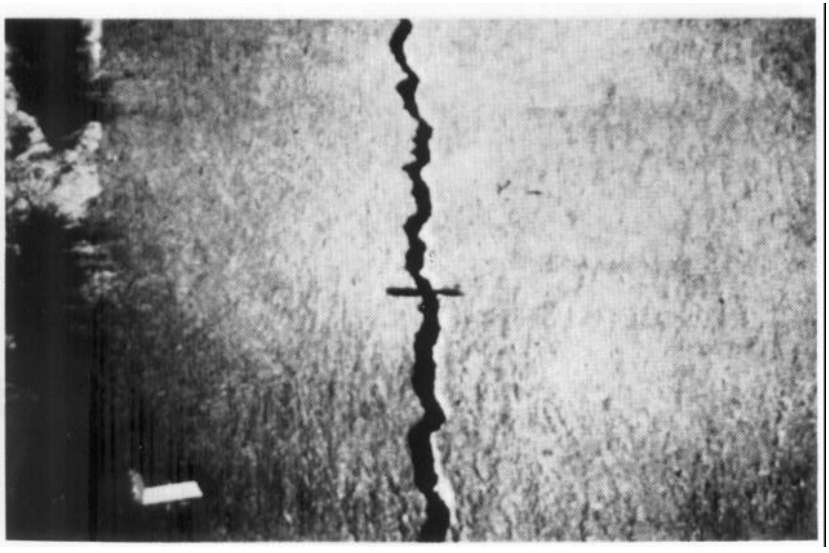


Figure 96. High severity crack

DURABILITY ("D") CRACKING

Description: Durability cracking is caused by the concrete's inability to withstand environmental factors such as freeze-thaw cycles. It usually appears as a pattern of cracks running parallel to a joint or linear crack. A dark coloring can usually be seen around the fine durability cracks. This type of cracking may eventually lead to disintegration of the concrete within 1 to 2 feet (.3 to .6 meters) of the joint or crack.

Severity Levels:

L - "D" cracking is defined by hairline cracks occurring in a limited area of the slab, such as one or two corners or along one joint. Little or no disintegration has occurred. No FOD potential. (Figures 97 and 98)

M -(1) "D" cracking has developed over a considerable amount of slab area with little or no disintegration or FOD potential; or (2) "D" cracking has occurred in a limited area of the slab, such as in one or two corners or along one joint, but pieces are missing and disintegration has occurred. Some FOD potential. (Figures 99 and 100)

H -"D" cracking has developed over a considerable amount of slab area with disintegration or FOD potential. (Figures 101 and 102)

How to Count: When the distress is located and rated at one severity it is counted as one slab. If more than one severity level is found, the slab is counted as having the higher severity distress. If "D" cracking is counted, scaling on the same slab should not be recorded.

Options for Repair:

L - Do nothing; Seal joints.

M - Full depth patch; Reconstruct joints.

H - Full depth patch; Reconstruct joints; Slab replacement.

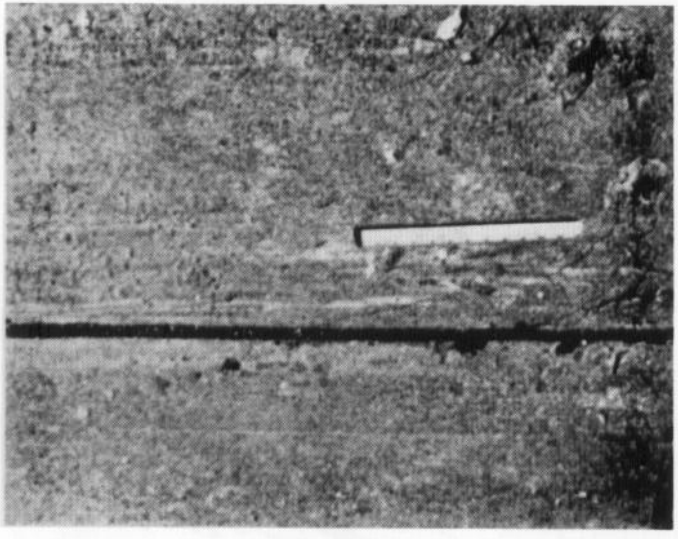


Figure 97. Low severity "D" cracking

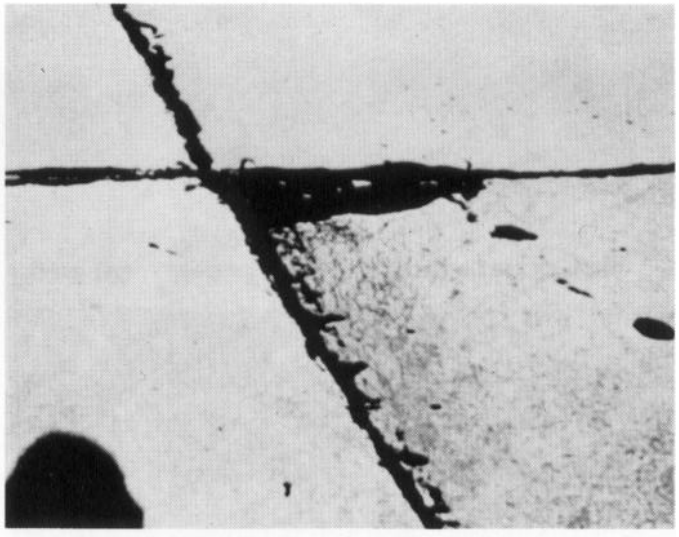


Figure 98. Low severity "D" cracking approaching medium severity (note slab is beginning to break-up near corner)

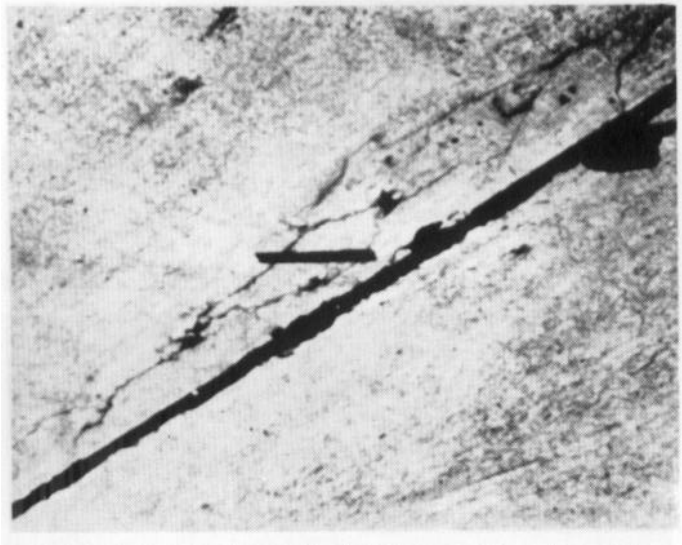


Figure 99. Medium severity “D” cracking

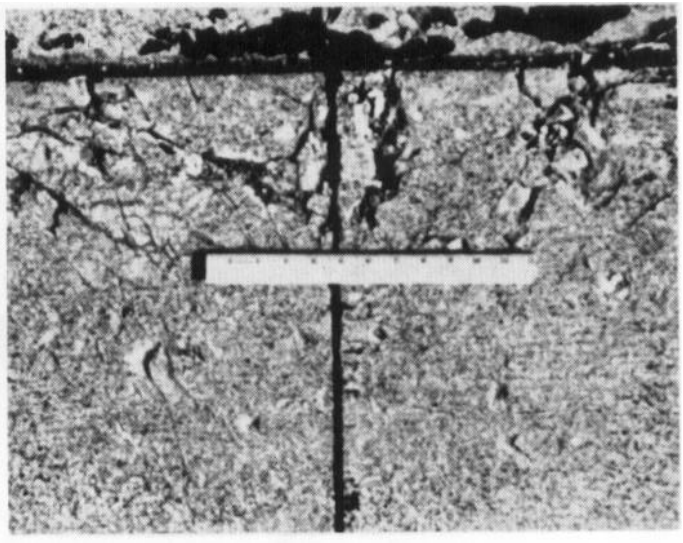


Figure 100. Medium severity “D” cracking occurring in limited area of slab

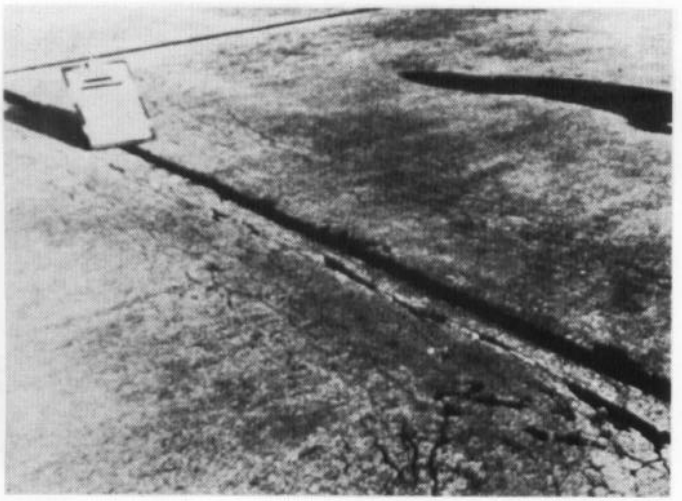


Figure 101. High seventy “D” cracking (the “D” cracking occurs over more than one joint with some disintegration)

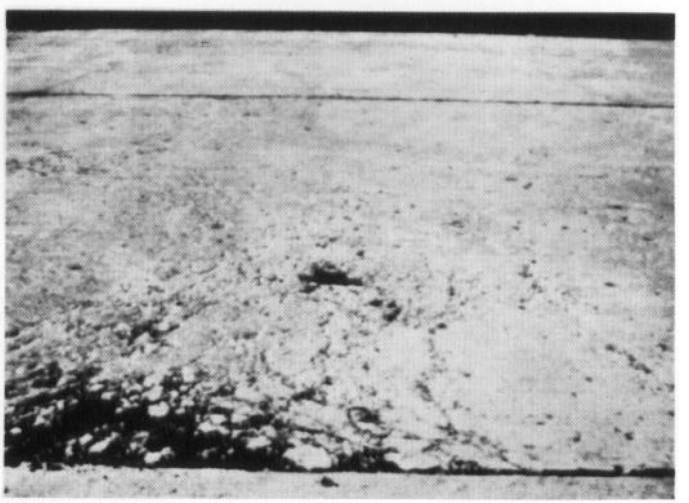


Figure 102. High severity “D” cracking

JOINT SEAL DAMAGE

Description: Joint seal damage is any condition which enables soil or rocks to accumulate in the joints or allows significant infiltration of water. Accumulation of incompressible materials prevents the slabs from expanding and may result in buckling, shattering, or spalling. A pliable joint filler bonded to the edges of the slabs protects the joints from accumulation of materials and also prevents water from seeping down and softening the foundation supporting the slab.

Typical types of joint seal damage are (1) stripping of joint sealant, (2) extrusion of joint sealant, (3) weed growth, (4) hardening of the filler (oxidation), (5) loss of bond to the slab edges, and (6) lack or absence of sealant in the joint.

Severity Levels:

L - Joint sealer is in generally good condition throughout the section. Sealant is performing well with only a minor amount of any of the above types of damage present. (Figure 103)

M -Joint sealer is in generally fair condition over the entire surveyed section, with one or more of the above types of damage occurring to a moderate degree. Sealant needs replacement within 2 years. (Figure 104)

H -Joint sealer is in generally poor condition over the entire surveyed section, with one or more of the above types of damage occurring to a severe degree. Sealant needs immediate replacement. (Figures 105 and 106)

How to Count: Joint seal damage is not counted on a slab-by-slab basis, but is rated based on the overall condition of the sealant in the sample unit.

Options for Repair:

L - Do nothing.

M - Seal joints.

H - Seal joints.

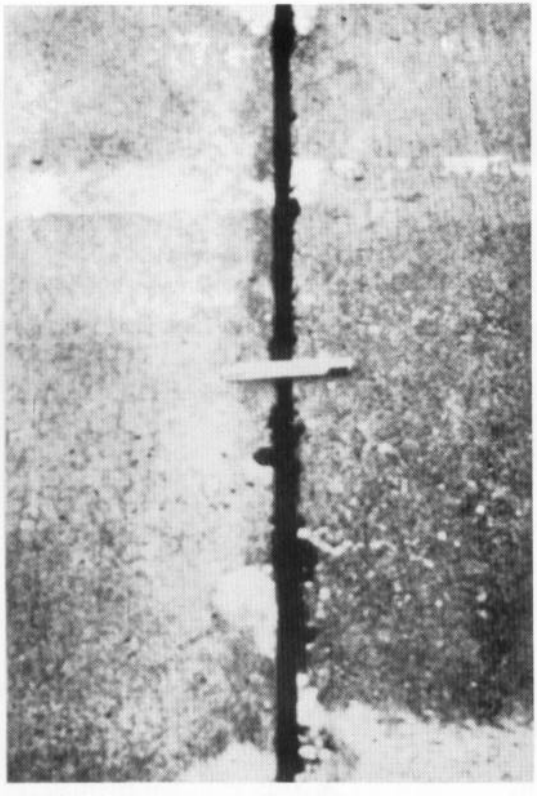


Figure 103. Low seventy joint seal damage (This condition existed on only a few joints in the pavement section. If all joint sealant were as shown it would have been rated medium)

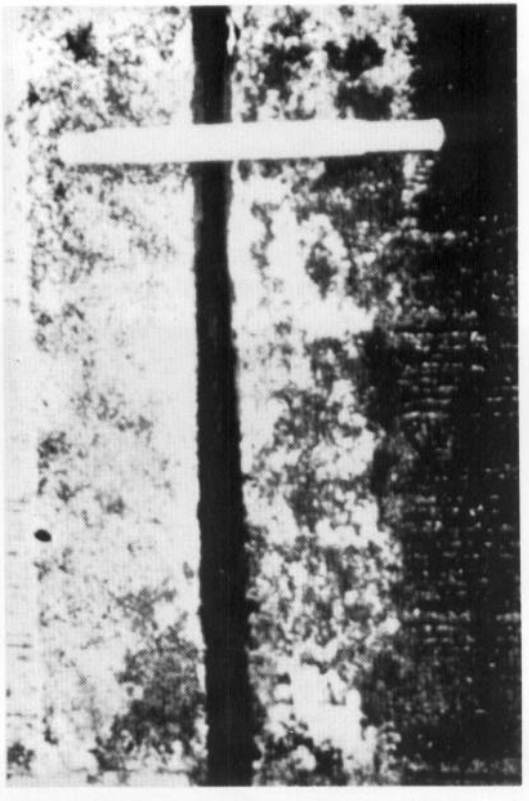


Figure 104. Medium severity joint seal damage (note that sealant has lost bond and is highly oxidized

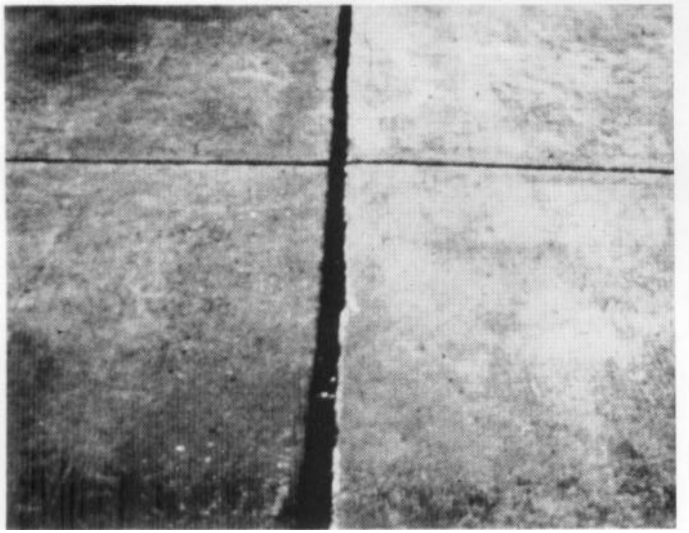


Figure 105. High severity joint seal damage (complete loss of sealant; joint is filled with incompressible material)

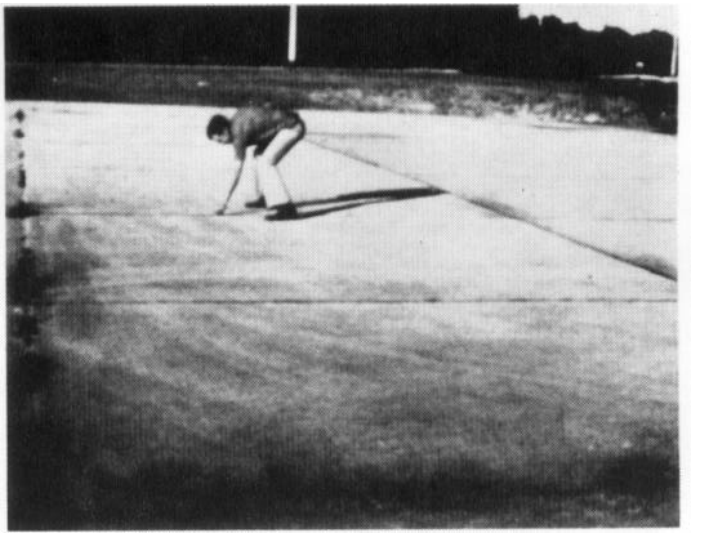


Figure 106. High severity joint seal damage (extensive amount of weed growth)

PATCHING, SMALL
[LESS THAN 5 SQUARE FEET (1.5 SQ M)]

Description: A patch is an area where the original pavement has been removed and replaced by a filler material. For condition evaluation, patching is divided into two types: small [less than 5 square feet (1.5 sq m)] and large [over 5 square feet (1.5 sq m)]. Large patches are described in the next section.

Severity Levels:

L - Patch is functioning well with little or no deterioration. (Figures 107 and 108)

M -Patch has deteriorated, and/or moderate spalling can be seen around the edges. Patch material can be dislodged with considerable effort (minor FOD potential). (Figures 109 and 110)

H - Patch has deteriorated, either by spalling around the patch or cracking within the patch, to a state which warrants replacement. (Figure 111)

How to Measure:

If one or more small patches having the same severity level are located in a slab, it is counted as one slab containing that distress. If more than one severity level occurs, it is counted as one slab with the higher severity level being recorded.

If a crack is repaired by a narrow patch [e.g., 4 to 10 inches (102 to 254 mm) wide], only the crack and not the patch should be recorded at the appropriate severity level. If the original distress of a patch is more severe than the patch itself the original distress type should be recorded.

Options for Repair:

L - Do nothing.

M - Replace patch.

H - Replace patch.

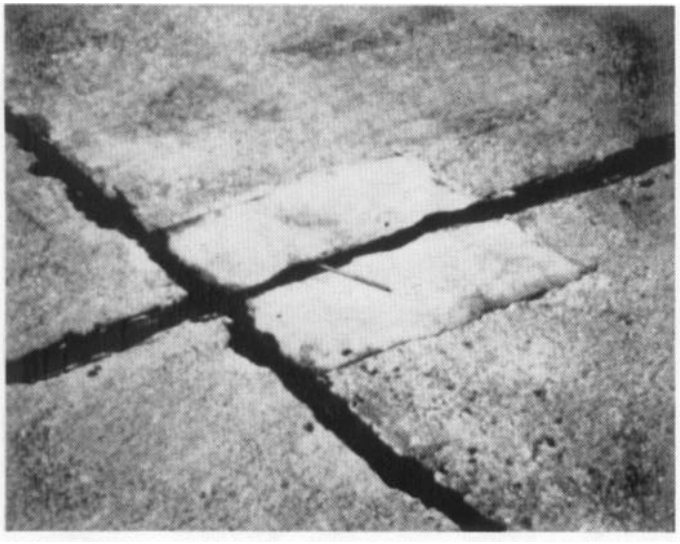


Figure 107. Low severity small patch

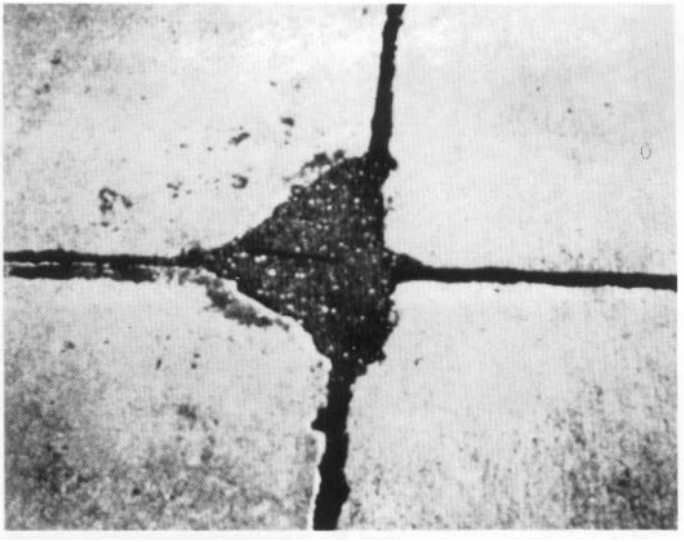


Figure 108. Low severity small patch

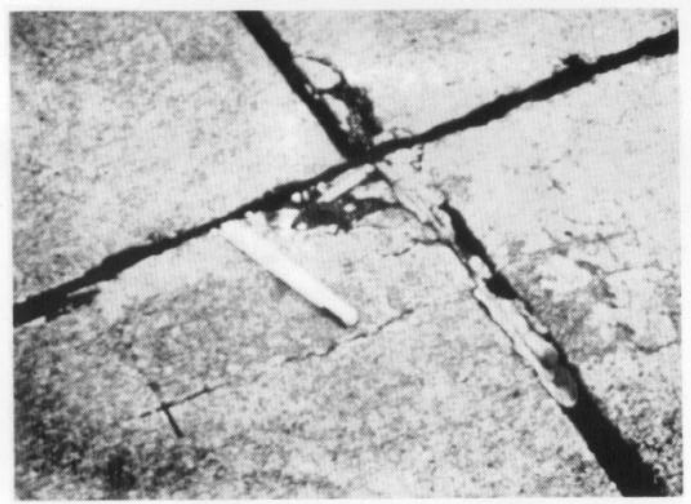


Figure 109. Medium severity small patch

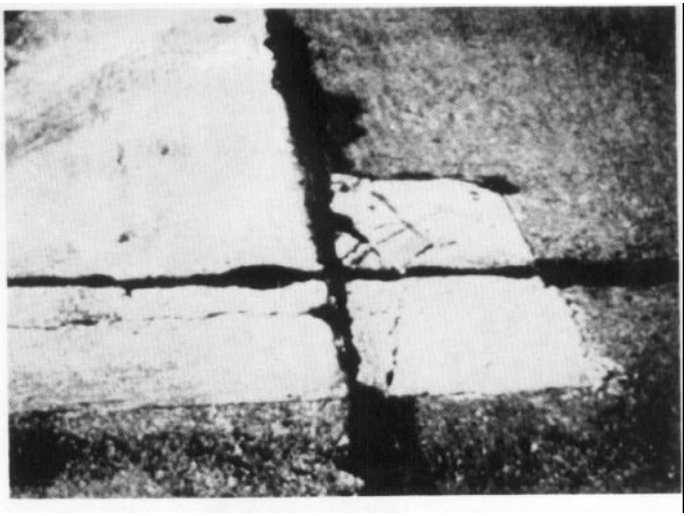


Figure 110. Medium severity small patch

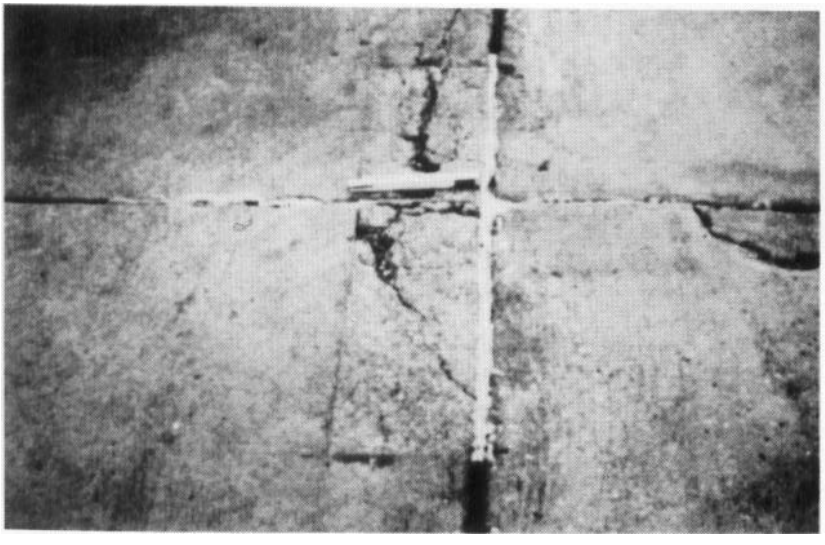


Figure 111. High severity small patch

PATCHING, LARGE (OVER 5 SQUARE FEET) AND UTILITY CUT

Description: Patching is the same as defined in the previous section. A utility cut is a patch that has replaced the original pavement because of placement of underground utilities. The severity levels of a utility cut are the same as those for regular patching.

Severity Levels:

L - Patch is functioning well with very little or no deterioration (Figures 112, 113, and 114)

M -Patch has deteriorated and/or moderate spalling can be seen around the edges. Patch material can be dislodged with considerable effort, causing some FOD potential. (Figure 115)

H - Patch has deteriorated to a state which causes considerable roughness and/or high FOD potential. The extent of the deterioration warrants replacement of the patch. (Figure 116)

How to Count: The criteria are the same as for small patches.

Options for Repair:

L - Do nothing

M - Seal cracks; Repair distressed area; Replace patch.

H - Replace patch; Slab replacement.

Patching (Large) 67

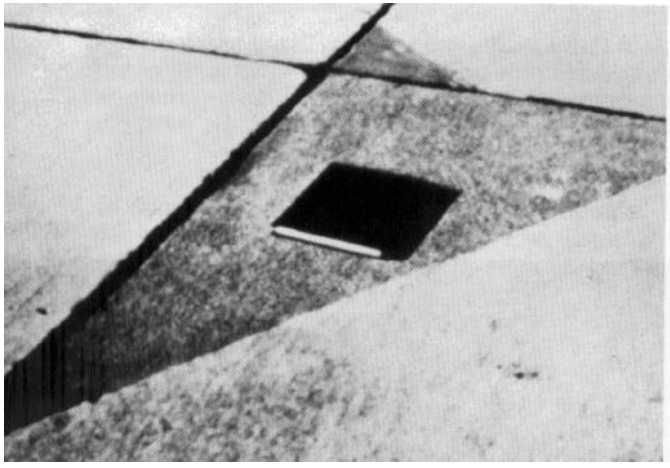


Figure 112. Low severity patch

Figure 113. Low seventy patch

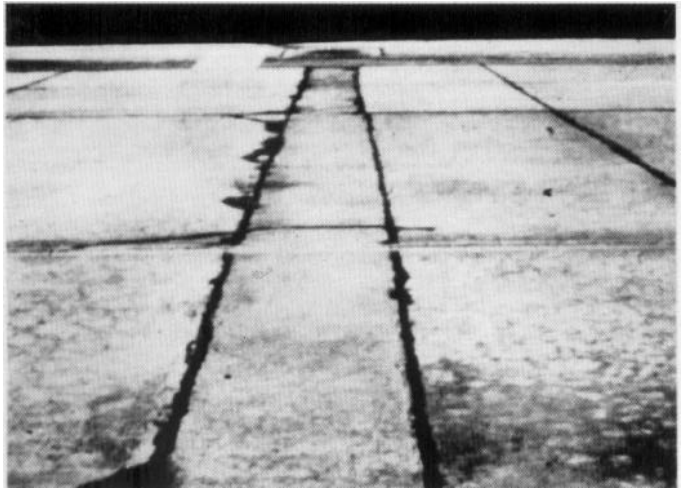


Figure 114. Low severity utility cut

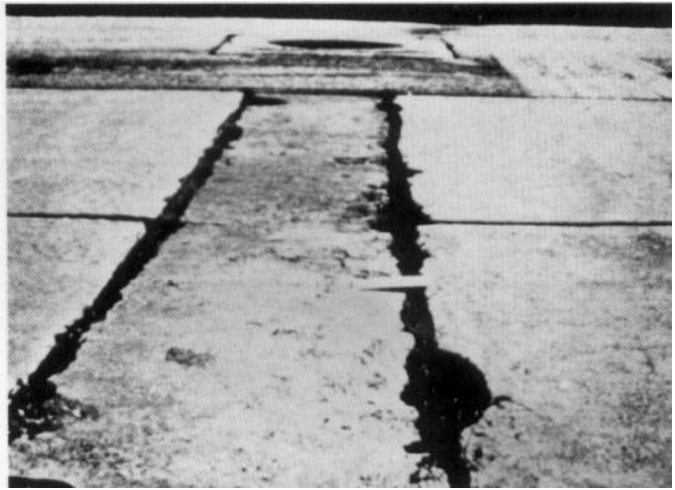


Figure 115. Medium severity utility cut

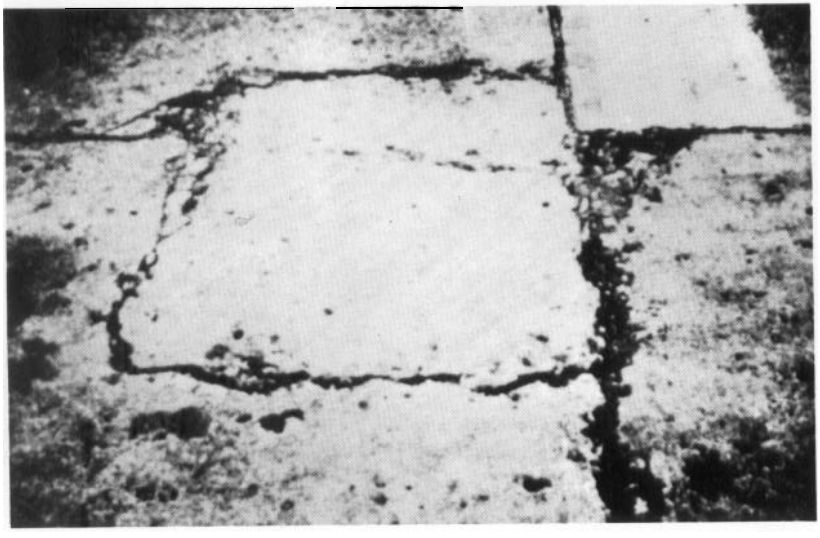


Figure 116. High severity patch

POPOUTS

Description: A popout is a small piece of pavement that breaks loose from the surface due to freeze-thaw action in combination with expansive aggregates. Popouts usually range from approximately 1 inch (25.4 mm) to 4 inches (102 mm) in diameter and from 1/2 inch (12.7 mm) to 2 inches (50.8mm) deep.

Severity Levels: No degrees of severity are defined for popouts. However, popouts must be extensive before they are counted as a distress; i.e., average popout density must exceed approximately three popouts per square yard over the entire slab area. (Figure 117)

How to Count: The density of the distress must be measured. If there is any doubt about the average being greater than three popouts per square yard (per square meters) at least three random 1 -square yard (1 -square meter) areas should be checked. When the average is greater than this density, the slab is counted.

Options for Repair: Do nothing.

Popouts 66

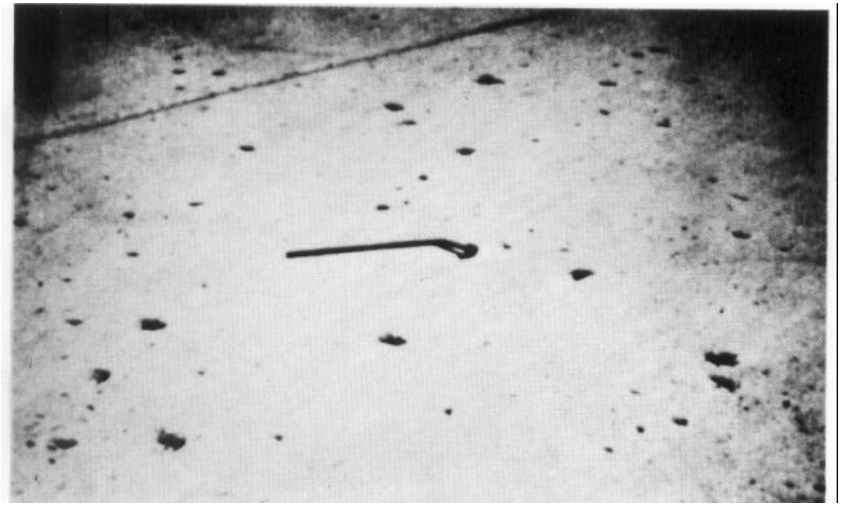


Figure 117. Popouts

PUMPING

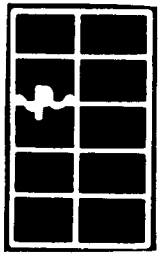
Description: Pumping is the ejection of material by water through joints or cracks, caused by deflection of the slab under passing loads. As the water is ejected, it carries particles of gravel, sand, clay, or silt, resulting in a progressive loss of pavement support. Surface staining and base or subgrade material on the pavement close to joints or cracks are evidence of pumping. Pumping near joints indicates poor joint sealer and loss of support which will lead to cracking under repeated loads.

Severity Levels: No degrees of severity are defined. It is sufficient to indicate that pumping exists. (Figures 118, 119, 120 and 121)

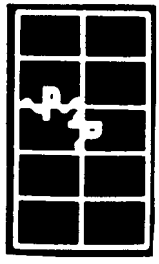
How to Count: Slabs are counted as follows (see diagram): one pumping joint between two slabs is counted as two slabs. However, if the remaining joints around the slab are also pumping, one slab is added per additional pumping joint (see diagram below).

Options for Repair: Seal cracks and joints; Underseal.

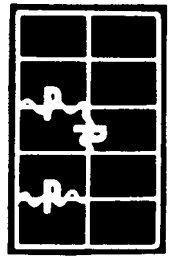
Two slabs counted



Three slabs counted



Five slabs counted



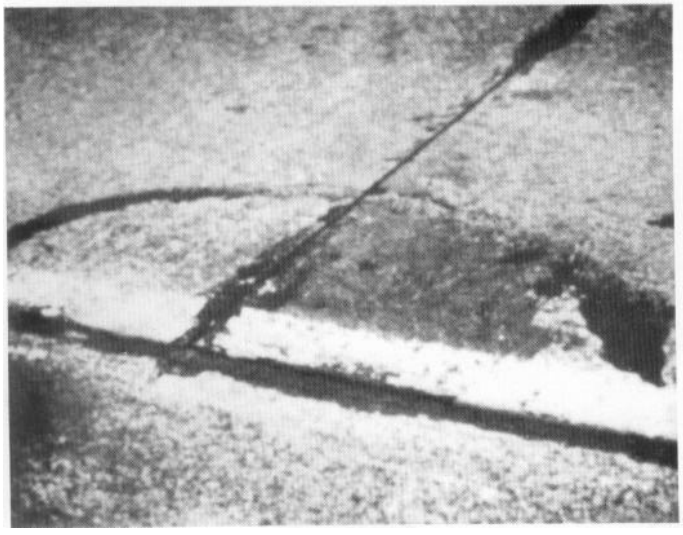


Figure 118. Pumping (note fine material on surface that has been pumped out causing corner break)

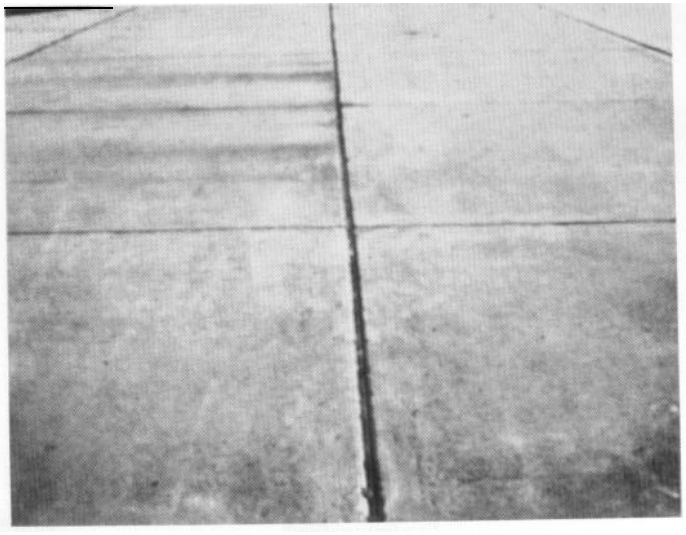


Figure 119. Pumping (note stains on pavement)

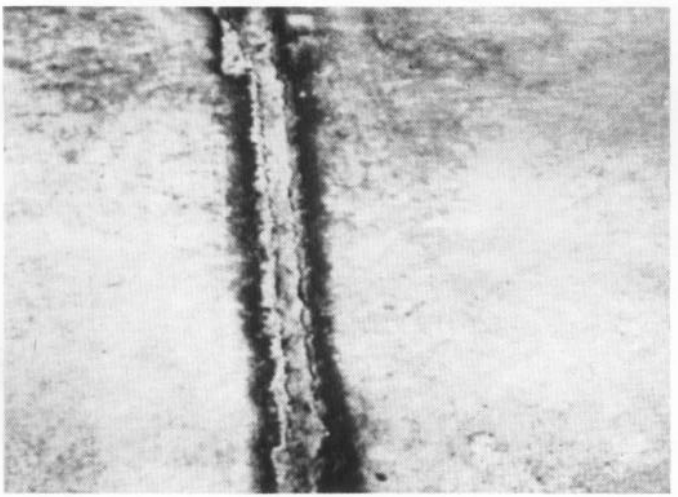


Figure 120. Pumping (close-up of fine materials collecting in the joint)

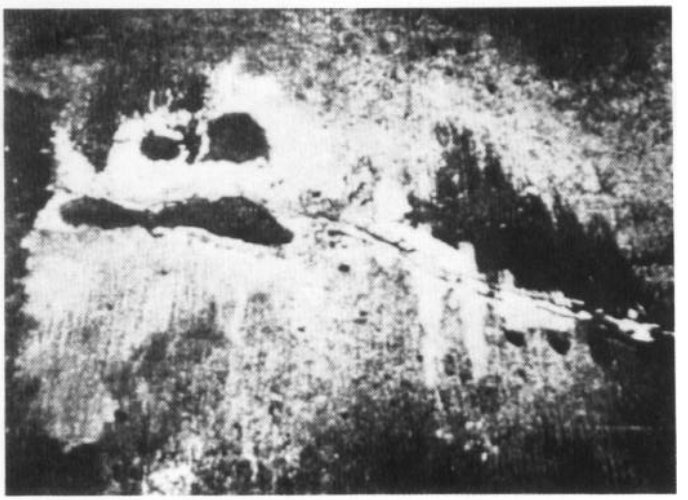


Figure 121. Pumping

SCALING, MAP CRACKING, AND CRAZING

Description: Map cracking or crazing refers to a network of shallow, fine, or hairline cracks which extend only through the upper surface of the concrete. The cracks tend to intersect at angles of 120 degrees. Map cracking or crazing is usually caused by overfinishing the concrete, and may lead to scaling of the surface, which is the breakdown of the slab surface to a depth of approximately 1/4 inch (6.4mm) to 1/2 inch (12.7mm). Scaling may also be caused by deicing salts, improper construction, freeze-thaw cycles, and poor aggregate. Another recognized source of distress is the reaction between the alkalies (Na20 and K20) in some cements and certain minerals in some aggregates. Products formed by the reaction between the alkalies and aggregate results in expansions that cause a breakdown in the concrete. This generally occurs throughout the slab and not just at joints where “D” cracking normally occurs.

Severity Levels:

L - Crazing or map cracking exists over most of the slab area; the surface is in good condition with no scaling. (Figure 122)

NOTE: The low severity level is an indicator that scaling may develop in the future. A slab should only be counted if, in the judgment of the pavement inspector, future scaling is likely to occur within 2 to 3 years.

M -Slab is scaled over approximately 5 percent or less of the surface, causing some FOD potential. (Figure 123)

H -Slab is severely scaled, causing a high FOD potential. Usually more than 5 percent of the surface is affected. (Figures 124, 125, and 126)

How to Count: If two or more levels of severity exist on a slab, the slab is counted as one slab having the maximum level of severity. For example, if both low severity crazing and medium scaling exist on one slab, the slab is counted as one slab containing medium scaling. If “D” cracking is counted, scaling is not counted.

Options for Repair: L - Do nothing.

M - Partial depth patch; Slab replacement.

H - Slab replacement.

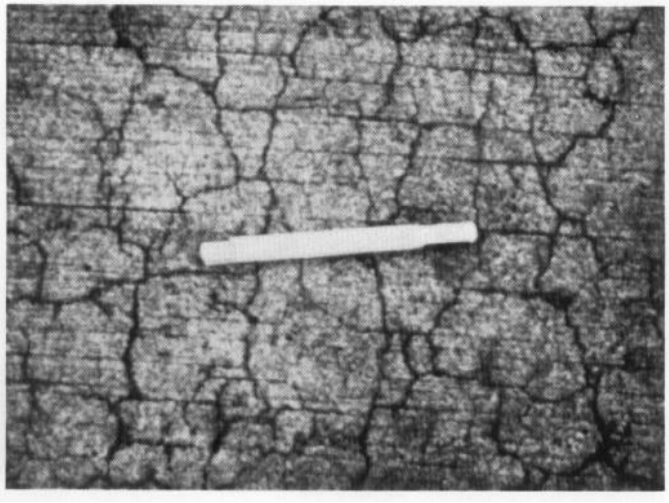


Figure 122. Low severity crazing

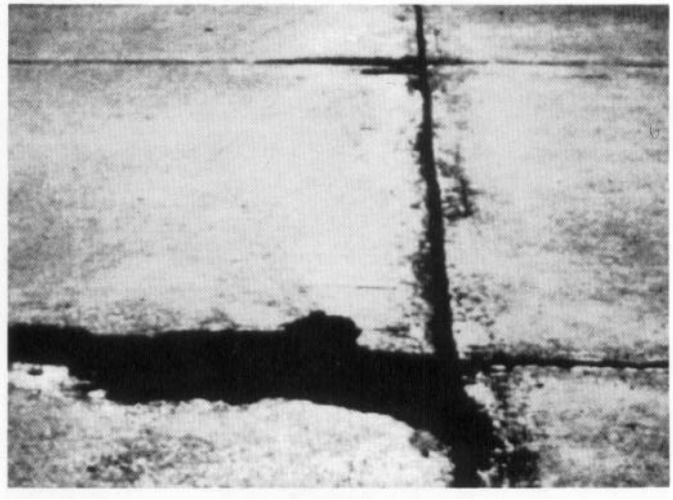


Figure 123. Medium severity scaling

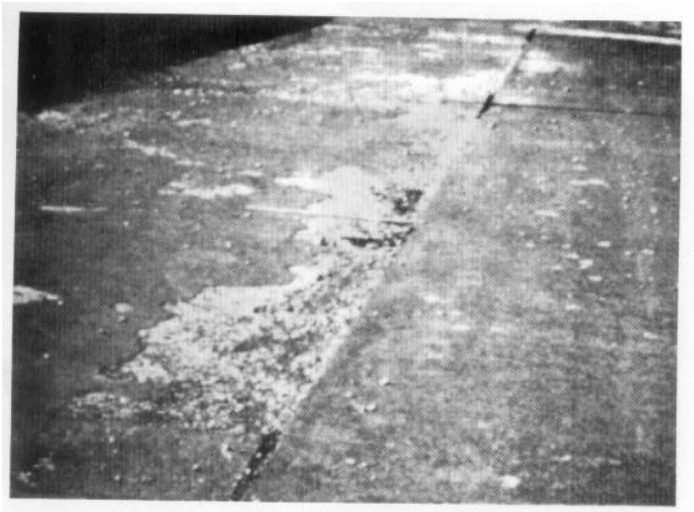


Figure 124. High severity scaling

Figure 125. Close-up of high severity scaling

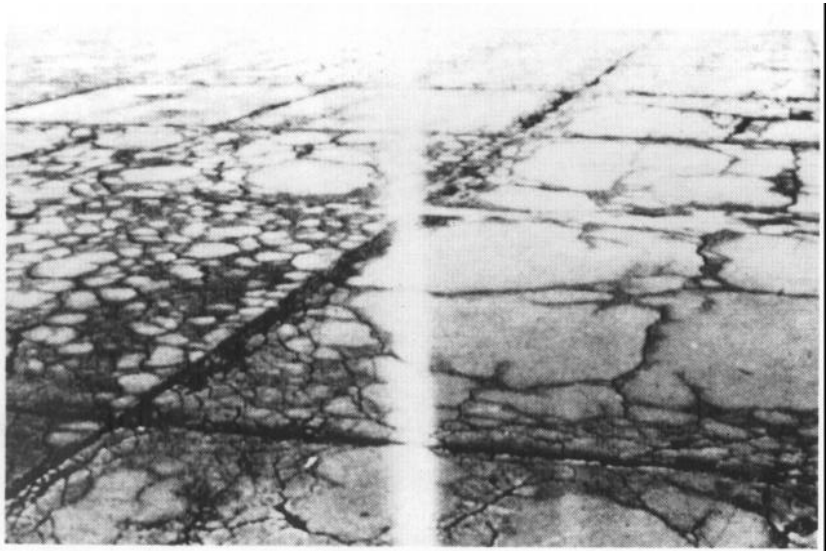


Figure 126. High severity scaling caused by alkali aggregate reaction

SETTLEMENT OR FAULTING

Description: Settlement or faulting is a difference of elevation at a joint or crack caused by upheaval or consolidation.

Severity Levels: Severity levels are defined by the difference in elevation across the fault and the associated decrease in ride quality and safety as severity increases.

Difference in elevation:

	Runways/Taxiways	Aprons
L	<1/4 inch 6.4mm	1/8 < 1/2 inch (Figures 127 and 128) 3.2 - 12.7mm
M	1/4-1/2 inch 6.4-12.7mm	1/2-1 inch (Figure 129) 12.7-25.4mm
H	>1/2 inch 12.7mm	>1 inch (Figures 130 and 131) 25.4mm

How to Count: In counting settlement, a fault between two slabs is counted as one slab. A straightedge or level should be used to aid in measuring the difference in elevation between the two slabs.

Settlement 71

Options for Repair:

L* - Do nothing.

M* - Slab grinding.

H* - Slab grinding; Slab replacement.

* Check for joint seal damage and voids. Consider undersealing and joint seal project.

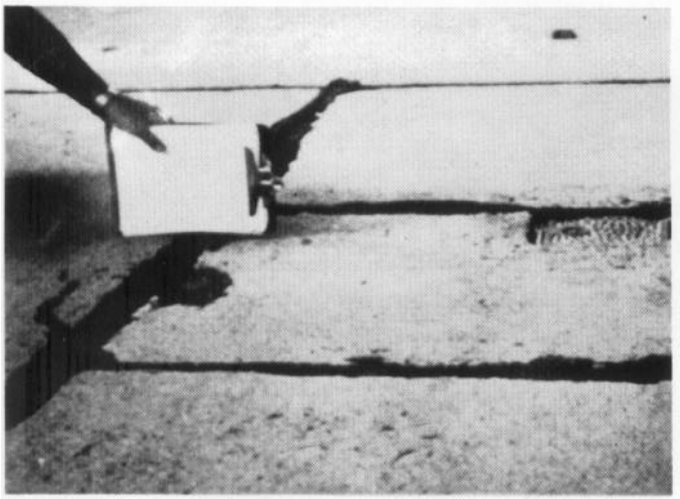


Figure 127. Low severity settlement (3/8 inch) on apron

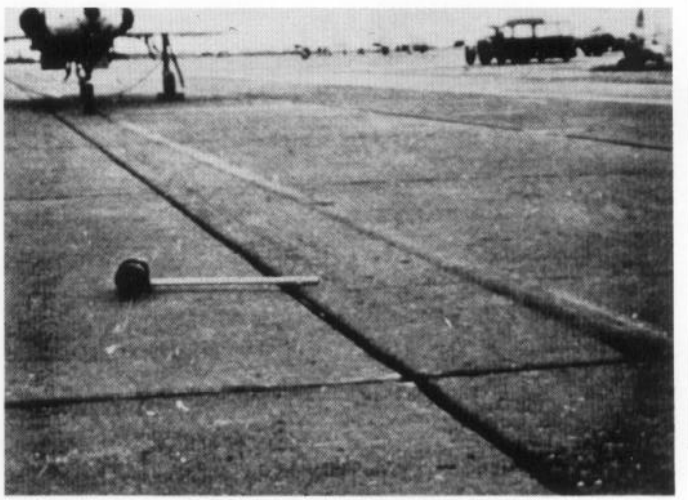


Figure 128. Low severity settlement on apron

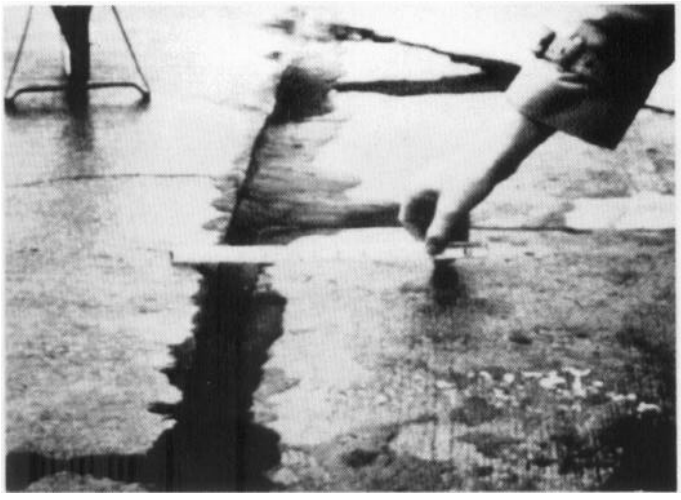


Figure 129. Medium severity settlement on apron (>1/2 inch)

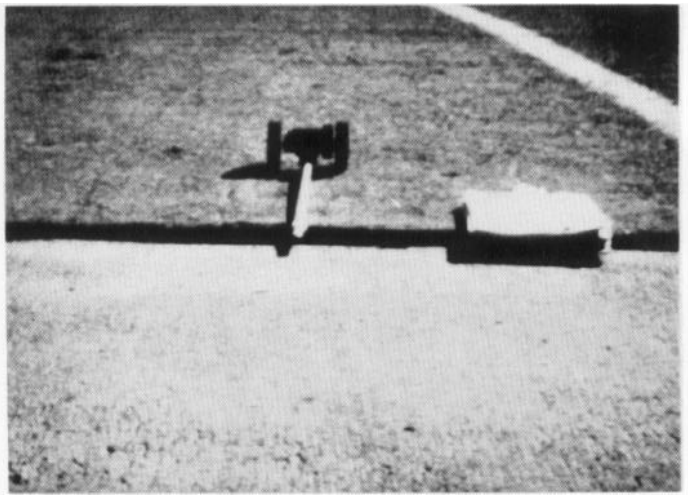


Figure 130. High severity settlement on taxiway/runway (3/4 inch)

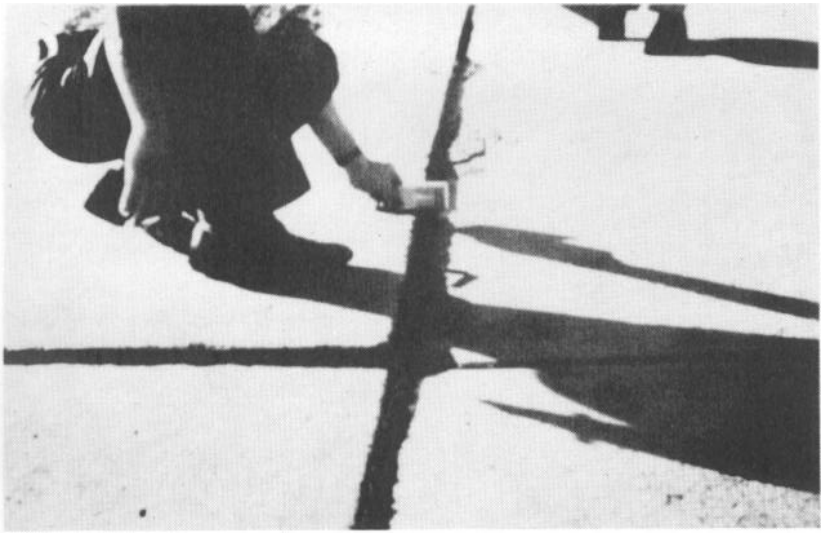


Figure 131. High severity settlement

SHATTERED SLAB/INTERSECTING CRACKS

Description: Intersecting cracks are cracks that break into four or more pieces due to overloading and/or inadequate support. The high severity level of this distress type, as defined below, is referred to as a shattered slab. If all pieces or cracks are contained within a corner break, the distress is categorized as a severe corner break.

Severity Levels:

L - Slab is broken into four or five pieces with the vast majority of the cracks (over 85 percent) of low severity. (Figures 132 and 133)

M -(1) Slab is broken into four or five pieces with over 15 percent of the cracks of medium severity (no high severity cracks); or (2) slab is broken into six or more pieces with over 85 percent of the cracks of low severity. (Figures 134 and 135)

H -At this level of severity the slab is called shattered: (1) slab is broken into four or five pieces with some or all of the cracks of high severity; (2) slab is broken into six or more pieces with over 15 percent of the cracks of medium or high severity. (Figure 136)

How to Count: No other distress such as scaling, spalling, or durability cracking should be recorded if the slab is medium or high severity level since the severity of this distress would affect the slab's rating substantially.

Shattered Slab 72

Options for Repair:

L - Seal cracks.

M - Seal cracks; Full depth patch; Slab replacement.

H - Full depth patch; Slab replacement.

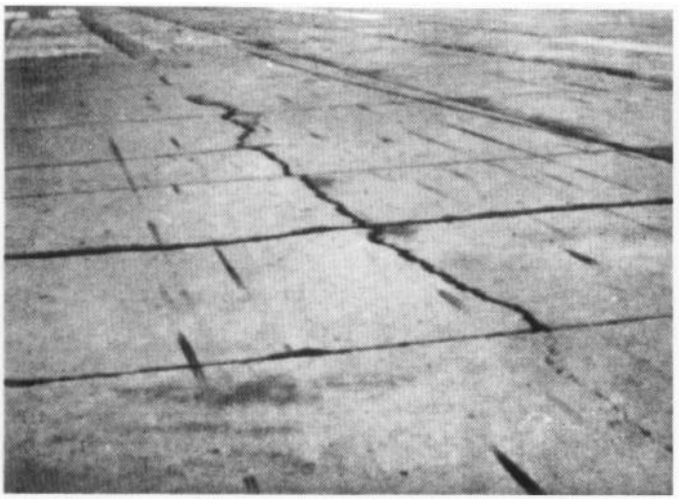


Figure 132. Low severity intersecting cracks

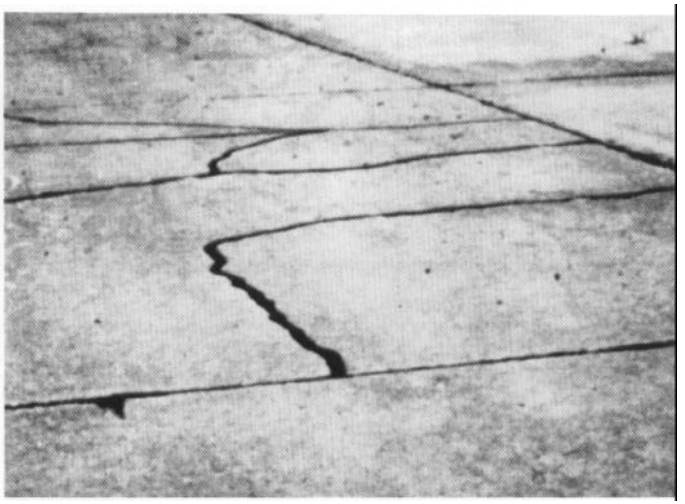


Figure 133. Low severity intersecting cracks

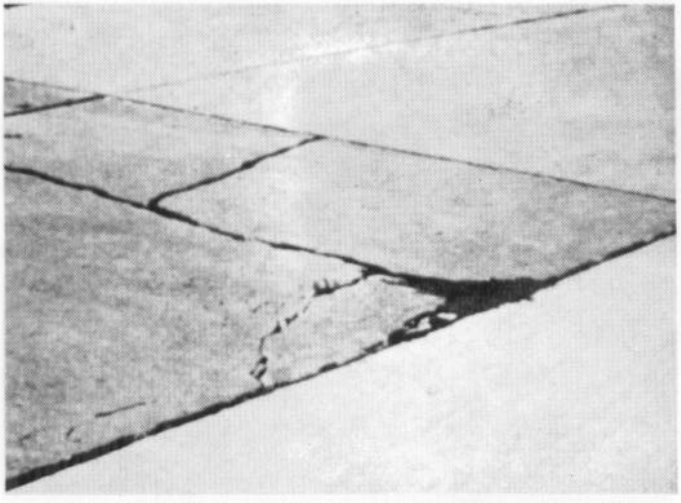


Figure 134. Medium severity intersecting cracks

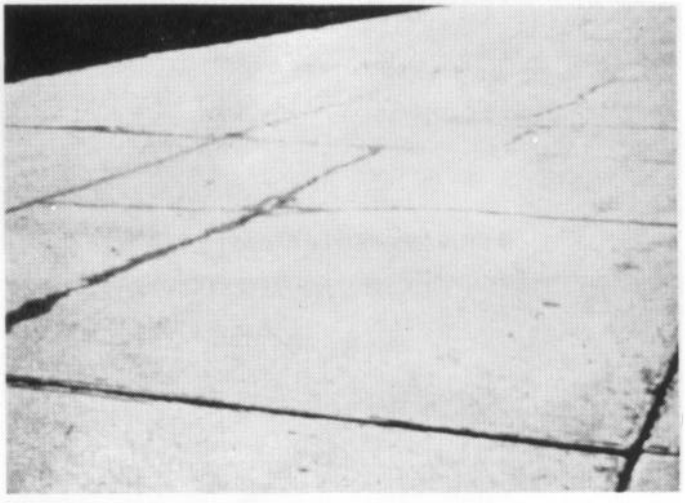


Figure 135. Medium seventy intersecting cracks

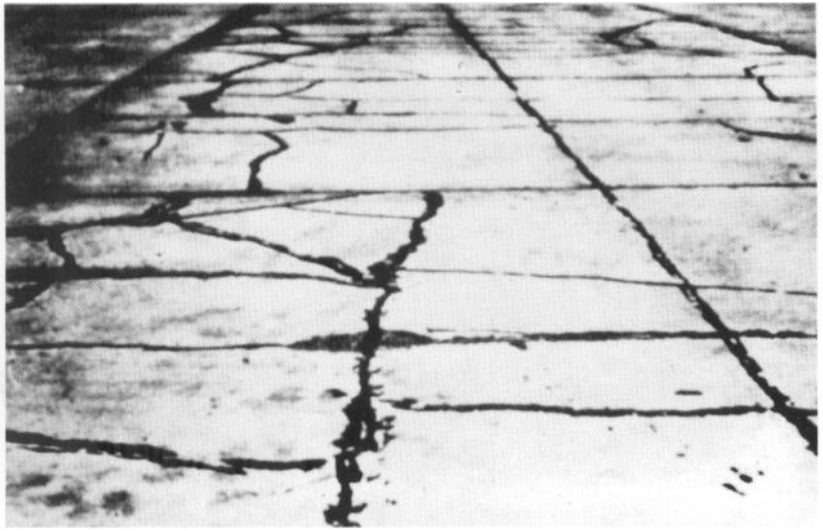


Figure 136. Shattered slab

SHRINKAGE CRACKS

Description: Shrinkage cracks are hairline cracks that are usually only a few feet long and do not extend across the entire slab. They are formed during the setting and curing of the concrete and usually do not extend through the depth of the slab.

Severity Levels: No degrees of severity are defined. It is sufficient to indicate that shrinkage cracks exist. (Figures 137, 138, and 139)

How to Count: If one or more shrinkage cracks exist on one particular slab, the slab is counted as one slab with shrinkage cracks.

Options for Repair: Do nothing.

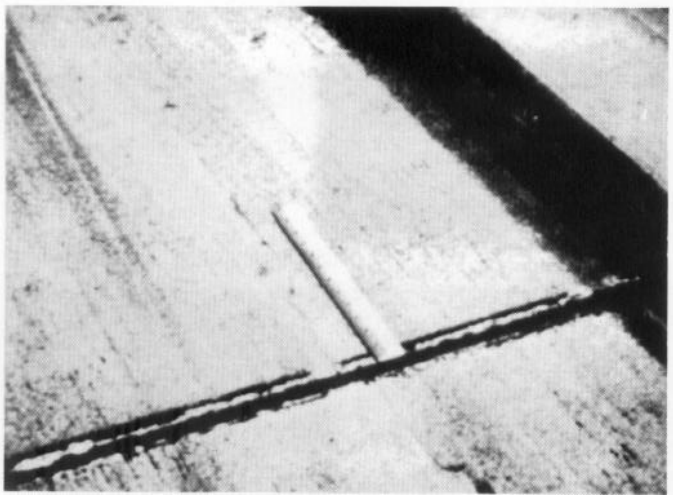


Figure 137. Shrinkage crack

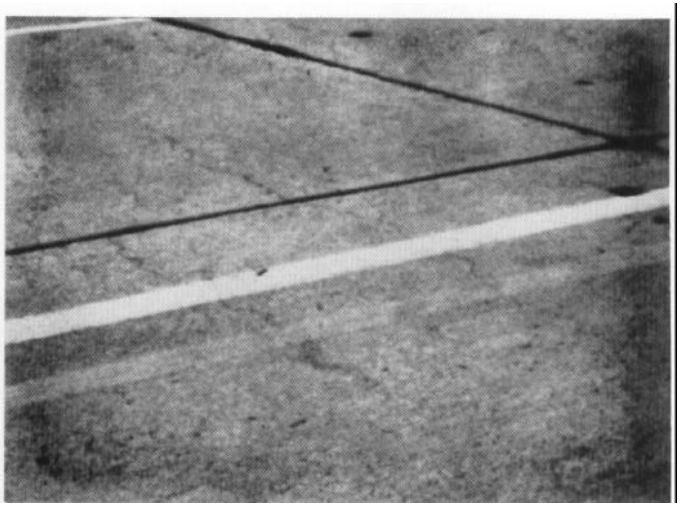


Figure 138. Shrinkage cracks

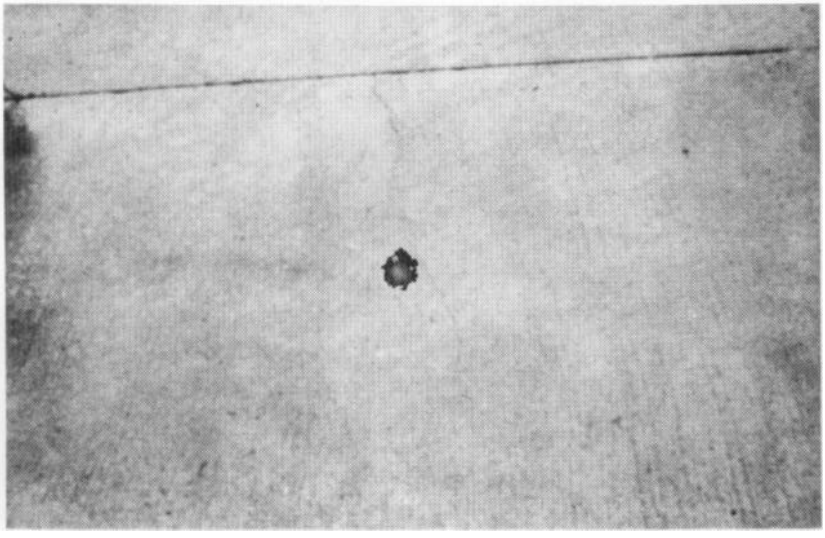


Figure 139. Shrinkage cracks

SPALLING (TRANSVERSE AND LONGITUDINAL JOINT)

Description: Joint spalling is the breakdown of the slab edges within 2 feet (.6m) of the side of the joint. A joint spall usually does not extend vertically through the slab, but intersects the joint at an angle. Spalling results from excessive stresses at the joint or crack caused by infiltration of incompressible materials or traffic loads. Weak concrete at the joint (caused by overworking) combined with traffic loads is another cause of spalling.

Severity Levels:

L - a. Spall over 2 feet (.6m) long: (1) spall is broken into no more than three pieces defined by low or medium severity cracks; little or no FOD potential exists; or (2) joint is lightly frayed; little or no FOD potential exists. (Figures 140 and 141)

b. Spall less than 2 feet (.6m) long: spall is broken into pieces or fragmented, little FOD or tire damage potential exists. (Figure 142)

M - a. Spall over 2 feet (.6 m) long: (1) spall is broken into more than three pieces defined by light or medium cracks; (2) spall is broken into no more than three pieces with one or more of the cracks being severe with some FOD potential existing; or (3) joint is moderately frayed, with some FOD potential. (Figure 143)

b. Spall less than 2 feet (.6 m) long: spall is broken into pieces or fragmented, with some of the pieces loose or absent, causing considerable FOD or tire damage potential. (Figure 144)

H - a. Spall over 2 feet (.6 m) long: (1) spall is broken into more than three pieces defined by one or more high severity cracks with high FOD potential; or (2) joint is severely frayed, with high FOD potential. (Figures 145 and 146)

NOTE: If less than 2 feet (.6 m) of the joint is lightly frayed, the spall should not be counted.

How to Count: If the joint spall is located along the edge of one slab, it is counted as one slab with joint spalling. If spalling is located on more than one edge of the same slab, the edge having the highest severity is counted and recorded as one slab. Joint spalling can also occur along the edges of two adjacent slabs. If this is the case, each slab is counted as having joint spalling. If a joint spall is small enough to be filled during a joint seal repair, it should not be recorded.

Options for Repair:

L - Do nothing.

M - Partial depth patch

H - Partial depth patch.

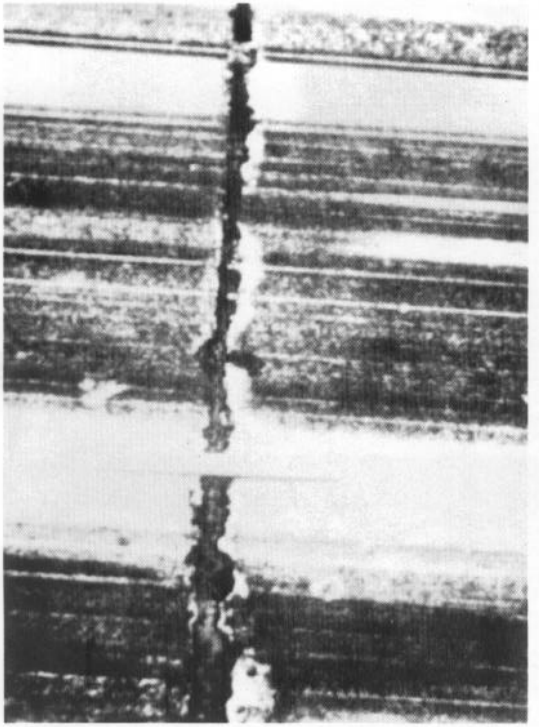


Figure 140. Low seventy joint spalling (if the frayed area was less than 2 feet long it would not be counted)

Figure 141. Low severity joint spall

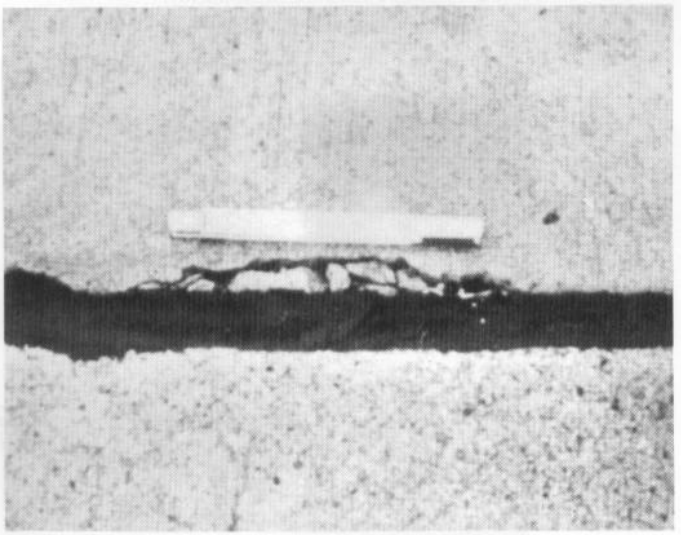


Figure 142. Low severity joint spall

Figure 143. Medium severity joint spall

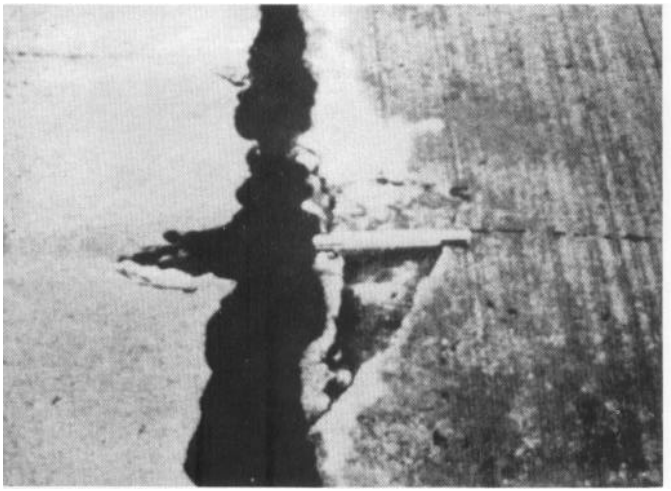


Figure 144. Medium severity joint spall

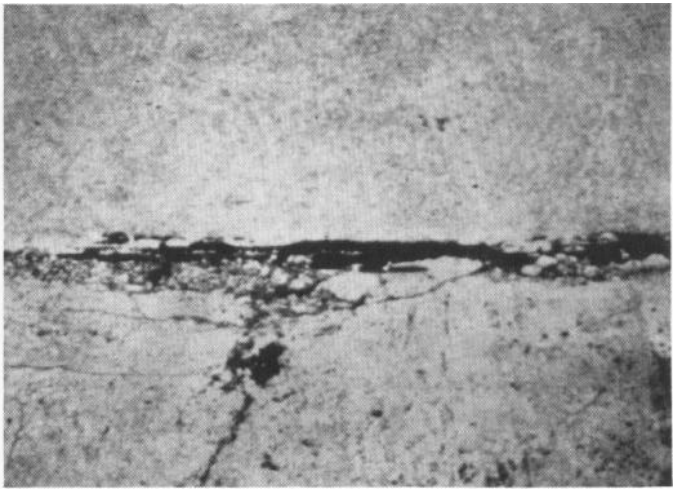


Figure 145. High severity joint spall

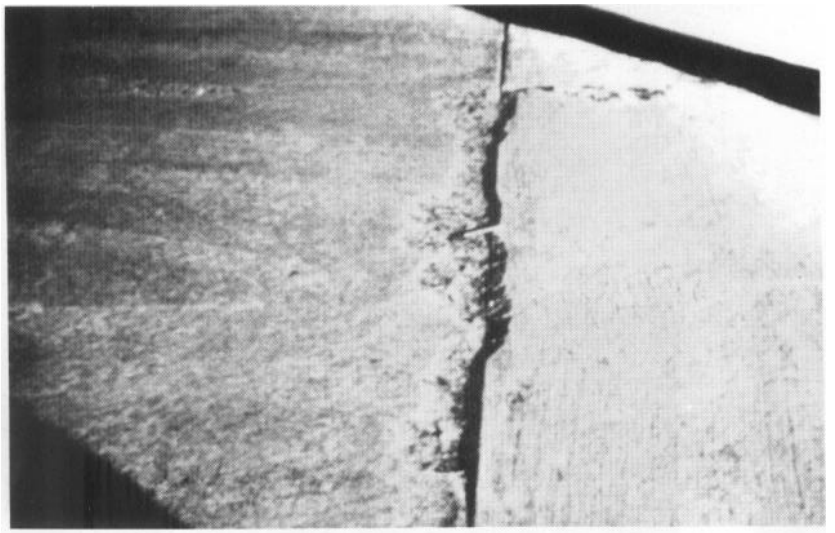


Figure 146. High severity joint spall

SPALLING (CORNER)

Description: Corner spalling is the raveling or breakdown of the slab within approximately 2 feet (.6 m) of the corner. A corner spall differs from the corner break in that the spall angles downward to intersect the joint, while a break extends vertically through the slab.

Severity Levels:

L - One of the following conditions exists: (1) spall is broken into one or two pieces defined by low severity cracks (little or no FOD potential), (2) spall is defined by one medium severity crack (little or no FOD potential.) (Figures 147 and 148)

M -One of the following conditions exists: (1) spall is broken into two or more pieces defined by medium severity crack(s), and a few small fragments may be absent or loose; (2) spall is defined by one severe, fragmented crack that may be accompanied by a few hairline cracks; or (3) spall has deteriorated to the point where loose material is causing some FOD potential. (Figures 149 and 150)

H -One of the following conditions exists: (1) spall is broken into two or more pieces defined by high severity fragmented crack(s), with loose or absent fragments; (2) pieces of the spall have been displaced to the extent that a tire damage hazard exists; or (3) spall has deteriorated to the point where loose material is causing high FOD potential. (Figures 151 and 152)

How to Count: If one or more corner spalls having the same severity level are located in a slab. the slab is counted as one slab with corner spalling. If more than one severity level occurs, it is counted as one slab having the higher severity level.

Options for Repair:

L - Do nothing.

M - Partial depth patch.

H - Partial depth patch.

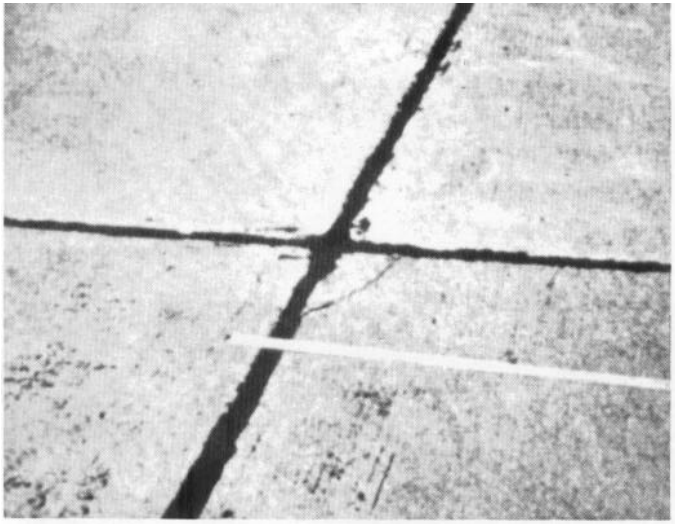


Figure 147. Low severity corner spall

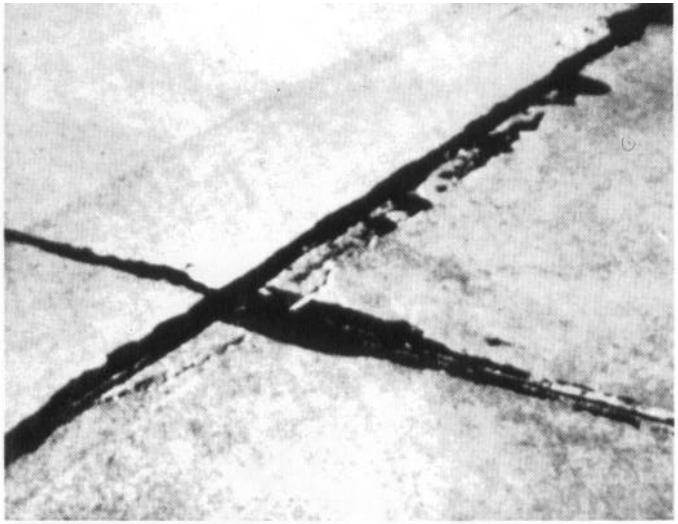


Figure 148. Low severity corner spall

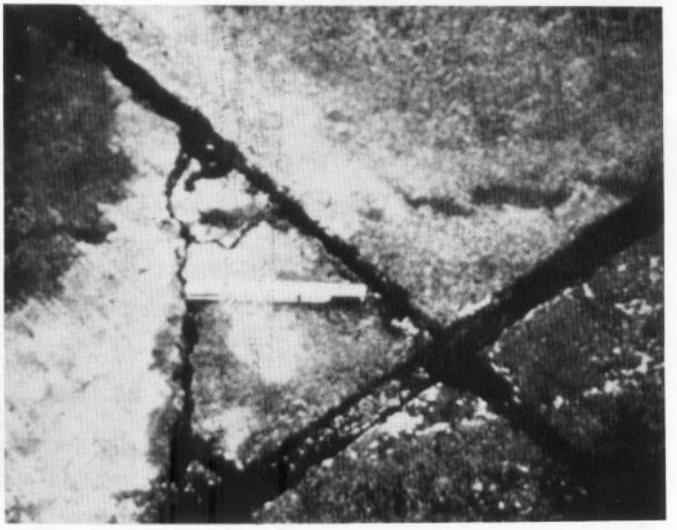


Figure 149. Medium severity corner spall

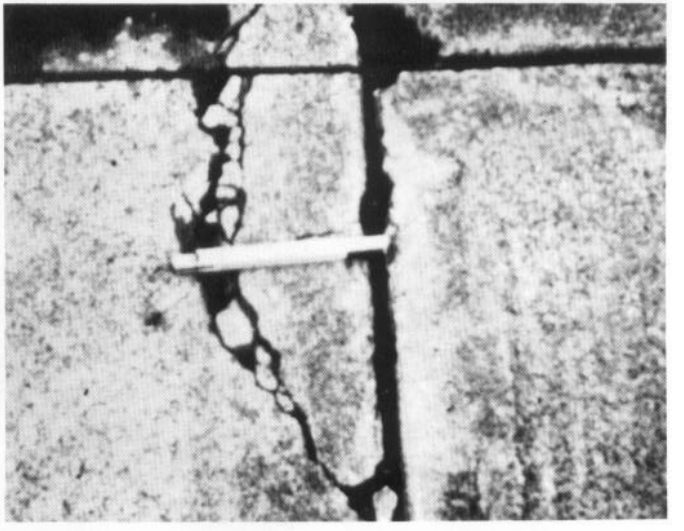


Figure 150. Medium seventy corner spall

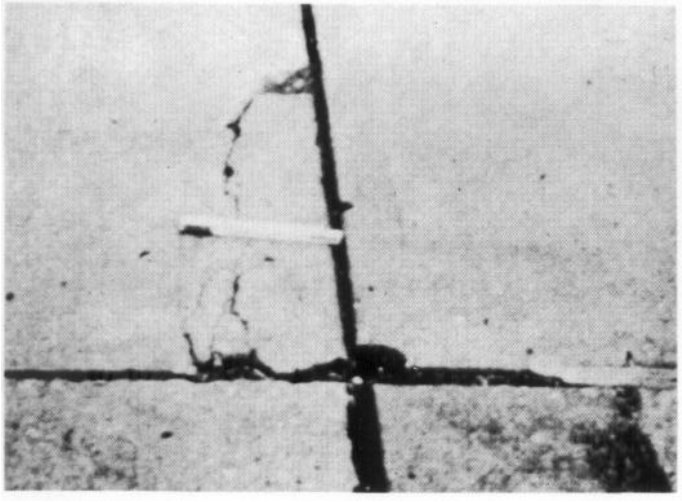


Figure 151. High severity corner spall

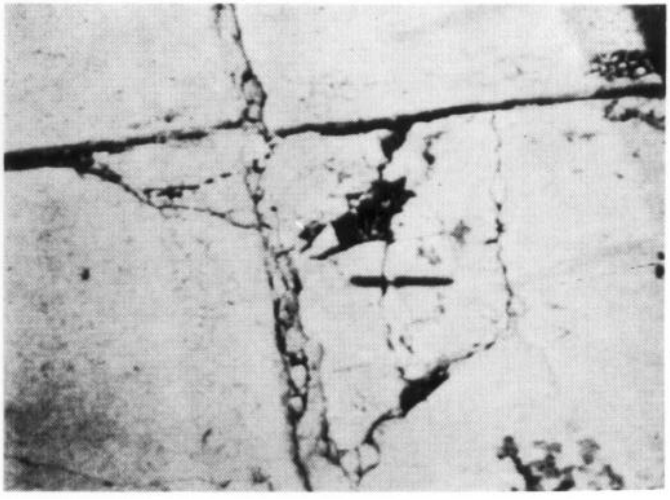


Figure 152. High severity corner spall